Reviews.

The Norwegian North Polar Expedition, 1893–1896. Scientific Results. Vol. II. Edited by Fridtjof Nansen. Longmans, Green & Co., London, New York, 1901. VI. H. Geelmuyden, *Astronomical Observations*, pp. 1–136, with two charts. VII. Aksel S. Steen, *Terrestrial Magnetism*, pp. 1–196, with 17 plates. VIII. O. E. Schiøtz, *Results of the Pendulum Observations and some Remarks on the Constitution of the Earth's Crust*, pp. 1–90.

The astronomical observations have their chief geological value in the accurate determination of localities. While they are thus fundamental and indispensable, they afford in themselves little matter of note for the reviewer. The observations were chiefly made by Captain Sigurd Scott-Hansen. They are abundant and bear evidence of having been taken with accuracy, and they thus contribute a valuable precision to all other observations dependent upon locality.

The second part of the volume is devoted to the discussion of the magnetic observations of the expedition, which were also made by Scott-Hansen. Concerning the value of these observations, Mr. Steen remarks: "It is of especial importance to obtain determinations of the magnetic elements from the polar regions, because the observations have naturally hitherto been rather scarce from these deserted wastes, containing large tracts where the foot of man has never yet trod, and whose physical conditions place all kinds of difficulties in the way of delicate scientific investigations. They are also important because the action of the earth's magnetic forces in these very regions, judging from the observations that have been obtained, presents peculiarities to which there is no parallel in the temperate and torrid zones." The general results are summarized in tables giving the declination, horizontal intensity, and inclination at the numerous localities of observation.

The third part, which relates to pendulum observations, has, without doubt, the greatest interest for geologists. These pendulum

observations are the first systematic determinations of the force of gravity over the great ocean depths. "The observations show that the gravity may be regarded as normal over the polar basin; and as it is not probable that this is a peculiarity of the Polar Sea, we are led to the assumption that the force of gravity is normal all over the great oceans. The increased attraction observed on oceanic islands must therefore only be due to the local attraction of the heaped-up masses at the bottom of the ocean that form the islands" (p. 63). This determination of the normal character of the force of gravity over the ocean depths, if its theoretical extension to all the ocean basins be justified, must be regarded as a contribution of the first order. The determination in the polar basin was made possible by the relative fixity of the vessel in the ice. The tremors which more or less constantly affect the polar ice sheets may perhaps have slightly influenced the results but probably in no serious way. Regarding the theoretical extension, it is however to be noted that these polar observations were nowhere made at a great distance from the edge of the continental plateau, and that the extent of the depression is undetermined, and that, furthermore, the depth of the sea is somewhat less than the average depth of the ocean. The polar basin is probably not, at most, much greater in extent than the Mediterranean basin, and may be much less. It would seem, therefore, that some reserve may be prudently exercised in accepting the assumption that the observations in the Polar Sea determine the force of gravity over the great ocean depths in general. In view of the importance of determining this beyond question, it may be suggested that attempts be made to make pendulum observations in the calm belts of the tropics. This suggestion is made on the assumption that the sea might there be found sufficiently calm to permit observations of approximate accuracy.

The discussion of the crust of the earth, which follows that of the pendulum observations, is less satisfactory than it might have been, owing to the limitation of the theoretical assumptions to a single line of hypothesis. Apparently the results might be appreciably different, if different hypotheses of the internal constitution of the earth had been assumed. The discussion proceeds upon the conception that all the differences in the density of the solid portion of the earth are confined to its superficial portion. This is doubtless in accord with present majority views based on deductions derived from prevalent theories as to the origin and early state of the earth, but it is none the

less unsatisfactory, because it involves some assumptions which are apparently incompatible with the necessary deductions of physics, and which must probably be abandoned, whatever may happen to speculative views of the earth's genesis. For example, it is assumed that there is now an inner nucleus of uniform density forming a perfect spheroid, and that the outer surface that is now the ocean bottom was originally nearly or quite on a level with that on the continents, and that the present oceanic depressions are the result of progressive sinking due to cooling. Lord Kelvin, however, is authority for the statement that "there seems to be no possibility that our present day continents could have risen to their present heights, or that the surface of the solid in its other parts could have sunk down to their present ocean depths, during the twenty or twenty-five million years which may have passed since the *consistentior status* began or during any time however long." (On the Age of the Earth as an Abode Fitted for Life, p. 706.) And this conclusion is supported by independent considerations. The thickness of the earth's crust is taken by Professor Schiøtz to be 0.02 of the earth's radius, or about eighty miles. If as supposed it rests upon a spheroidal nucleus of uniform density and perfect form, the difference in thickness in different parts amounts to fully 10 per cent. of its own thickness when reckoned only between plateaus and antiplateaus, neglecting mountain heights. A *difference* of contraction to the amount of 10 per cent. is quite incredible, as is also any remote approach to this amount. The *average* difference between the thickness of the crust beneath the continental plateaus and that beneath the ocean bottoms is, under the assumption made by the author, more than 3 per cent. of the whole crustal thickness, and this is more than can reasonably be attributed to any *difference* in contraction due to cooling. In view of these and other considerations, it would have been more satisfactory if the discussion had been extended to the postulates of other hypotheses of the inner constitution of the earth: among them, the assumption that an uneven distribution of density reaches to profound depths.

Nevertheless, it is a great gain to the study of the earth's dynamics that a treatment of the problem from the point of view of pendulum data extended to the ocean surface has been ventured, even though it be confined to a single line of hypothetical postulates.

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